

Table of Contents

<u>A Equipment</u>	<u>1</u>
<u>A.1 Survey Vessels</u>	<u>1</u>
<u>A.1.1 R/V Bay Hydro II</u>	<u>1</u>
<u>A.2 Echo Sounding Equipment</u>	<u>3</u>
<u>A.2.1 Side Scan Sonars</u>	<u>3</u>
<u>A.2.1.1 L3 Klein 5000</u>	<u>3</u>
<u>A.2.2 Multibeam Echosounders</u>	<u>5</u>
<u>A.2.2.1 RESON SeaBat 7125</u>	<u>5</u>
<u>A.2.3 Single Beam Echosounders</u>	<u>7</u>
<u>A.2.3.1 ODOM Echotrac CV 200 Vertical Beam Echosounder CV-200</u>	<u>8</u>
<u>A.2.4 Phase Measuring Bathymetric Sonars</u>	<u>9</u>
<u>A.2.5 Other Echosounders</u>	<u>9</u>
<u>A.3 Manual Sounding Equipment</u>	<u>9</u>
<u>A.3.1 Diver Depth Gauges</u>	<u>10</u>
<u>A.3.2 Lead Lines</u>	<u>10</u>
<u>A.3.3 Sounding Poles</u>	<u>11</u>
<u>A.3.4 Other Manual Sounding Equipment</u>	<u>11</u>
<u>A.4 Positioning and Attitude Equipment</u>	<u>11</u>
<u>A.4.1 Applanix POS/MV</u>	<u>11</u>
<u>A.4.2 DGPS</u>	<u>14</u>
<u>A.4.3 Trimble Backpacks</u>	<u>15</u>
<u>A.4.4 Laser Rangefinders</u>	<u>16</u>
<u>A.4.5 Other Positioning and Attitude Equipment</u>	<u>17</u>
<u>A.5 Sound Speed Equipment</u>	<u>17</u>
<u>A.5.1 Sound Speed Profiles</u>	<u>17</u>
<u>A.5.1.1 CTD Profilers</u>	<u>18</u>
<u>A.5.1.1.1 Sea-Bird Electronics CTD SBE 19 Plus 05M</u>	<u>18</u>
<u>A.5.1.2 Sound Speed Profilers</u>	<u>19</u>
<u>A.5.1.2.1 SeaBird Electronics, Inc. 19plus</u>	<u>19</u>
<u>A.5.2 Surface Sound Speed</u>	<u>20</u>
<u>A.5.2.1 DIGIBAR PRO 1.12</u>	<u>20</u>
<u>A.6 Horizontal and Vertical Control Equipment</u>	<u>21</u>
<u>A.6.1 Horizontal Control Equipment</u>	<u>21</u>
<u>A.6.2 Vertical Control Equipment</u>	<u>21</u>
<u>A.7 Computer Hardware and Software</u>	<u>21</u>

A.7.1 Computer Hardware	22
A.7.2 Computer Software	23
A.8 Bottom Sampling Equipment	25
A.8.1 Bottom Samplers	25
A.8.1.1 Unknown Unknown	25
B Quality Control	25
B.1 Data Acquisition	26
B.1.1 Bathymetry	26
B.1.2 Imagery	26
B.1.3 Sound Speed	27
B.1.4 Horizontal and Vertical Control	28
B.1.5 Feature Verification	28
B.1.6 Bottom Sampling	29
B.1.7 Backscatter	29
B.1.8 Other	29
B.2 Data Processing	29
B.2.1 Bathymetry	29
B.2.2 Imagery	32
B.2.3 Sound Speed	34
B.2.4 Horizontal and Vertical Control	35
B.2.5 Feature Verification	37
B.2.6 Backscatter	38
B.2.7 Other	38
B.3 Quality Management	38
B.4 Uncertainty and Error Management	39
B.4.1 Total Propagated Uncertainty (TPU)	39
B.4.2 Deviations	40
C Corrections To Echo Soundings	40
C.1 Vessel Offsets and Layback	40
C.1.1 Vessel Offsets	40
C.1.2 Layback	42
C.2 Static and Dynamic Draft	42
C.2.1 Static Draft	42
C.2.2 Dynamic Draft	43
C.3 System Alignment	43
C.4 Positioning and Attitude	45

<u>C.5 Tides and Water Levels</u>	<u>45</u>
<u>C.6 Sound Speed</u>	<u>46</u>
<u>C.6.1 Sound Speed Profiles</u>	<u>46</u>
<u>C.6.2 Surface Sound Speed</u>	<u>46</u>

Data Acquisition and Processing Report

R/V Bay Hydro II

Chief of Party: LTJG Megan R. Guberski

Year: 2011

Version: 1

Publish Date: 2010-08-04

A Equipment

A.1 Survey Vessels

A.1.1 R/V Bay Hydro II

<i>Name</i>	R/V Bay Hydro II	
<i>Hull Number</i>	S5401	
<i>Description</i>	R/V BAY HYDRO II was used for the acquisition and post-processing of all side scan-sonar (SSS) data, vertical-beam echo sounder (VBES) data, shallow-water multibeam (SWMB) data, sound speed profiles (SVP) and detached positions (DP'S) unless otherwise noted in the Descriptive Report. Vessel configuration and offset measurements are included in Appendix III of this report.	
<i>Utilization</i>	Three sonar systems (VBES, SWMB and SSS) were used to acquire data on this project. The methods and systems used to meet full-coverage was determined by the Hydrographer, and are in accordance with guidance provided in the Hydrographic Survey Project Instructions, NOAA's Hydrographic Surveys Specifications & Deliverables and NOAA's Field Procedures Manual. Bathymetric data were acquired using either VBES or SWMB systems. Side scan sonar was utilized for imagery and object detection.	
<i>Dimensions</i>	<i>LOA</i>	18 meters
	<i>Beam</i>	6.33 meters
	<i>Max Draft</i>	1.83 meters

<i>Most Recent Full Static Survey</i>	<i>Date</i>	2009-03-23
	<i>Performed By</i>	NGS H. Stewart Kuper Jr.
	<i>Discussion</i>	A NGS survey of R/V Bay Hydro II was performed on 23 March 2009 using optical levels.
<i>Most Recent Partial Static Survey</i>	Partial static survey was not performed.	
<i>Most Recent Full Offset Verification</i>	Full offset verification was not performed.	
<i>Most Recent Partial Offset Verification</i>	Partial offset verification was not performed.	
<i>Most Recent Static Draft Determination</i>	<i>Date</i>	2011-01-05
	<i>Method Used</i>	Steel Measuring Tape and Lead Line
	<i>Discussion</i>	Due to the large capacity of the Bay Hydro II's fuel tanks, the vessel's static draft changes noticeably as fuel is burned. For this reason, static draft measurements are made daily when acquiring MBES data. A leadline is used to find the distance from the top of the sonar strut, to the waterline. The Caris waterline measurement is then be calculated using values from the NGS survey.
<i>Most Recent Dynamic Draft Determination</i>	<i>Date</i>	2010-01-05
	<i>Method Used</i>	Echosounder Technique
	<i>Discussion</i>	Dynamic Draft values were determined on 05 Jan 2011, using the echosounder technique outline in the Field Procedures manual section 1.4.2.1.2.1. See Appendix 1.



Figure 1: R/V Bay Hydro II

A.2 Echo Sounding Equipment

A.2.1 Side Scan Sonars

A.2.1.1 L3 Klein 5000

<i>Manufacturer</i>	L3 Klein
<i>Model</i>	5000

<i>Description</i>	The Klein High Speed, High Resolution Side Scan (SSS) Sonar system is a beam-forming acoustic imagery device that is towed behind the R/V Bay Hydro II via an armored cable and a hydraulic A-frame. The KLEIN 5500 towfish operates at a frequency of 455 kHz with a vertical beam angle of 40°, and can resolve up to 5 discrete received beams per transducer stave. The integrated system includes a KLEIN 5500 light weight towfish, a tow cable telemetry system, and a Transceiver/Processing Unit (TPU). Positioning of the Towfish is calculated using CARIS SIPS, and is derived from the amount of cable out, the towfish depth (from the towfish pressure gage), the vessel's Course Made Good (CMG), and the vessels heading. Towfish altitude is maintained between 8% and 20% of the range scale. Vessel speed is adjusted during SSS acquisition to ensure that object detection density is met. Confidence checks are performed by noting changes in linear bottom features extending to the outer edges of the digital side scan image, and by verifying aids to navigation or other known features on the side scan record. The resolution of the system is: Along Track: 10cm out to 38 meters 20cm out to 75 meters 36 cm out to 150 meters Across Track: 3.75 cm				
<i>Serial Numbers</i>	<i>Vessel Installed On</i>	5401			
	<i>TPU s/n</i>	92964			
	<i>Towfish s/n</i>	101			
<i>Specifications</i>	<i>Frequency</i>	455 kilohertz			
	<i>Along Track Resolution</i>	<i>Resolution</i>	10 centimeters	20 centimeters	36 centimeters
		<i>Min Range</i>	0 meters	38 meters	75 meters
		<i>Max Range</i>			
	<i>Across Track Resolution</i>	0.0375 meters			
	<i>Max Range Scale</i>	100 meters			
<i>Manufacturer Calibrations</i>	Manufacturer calibration was not performed.				

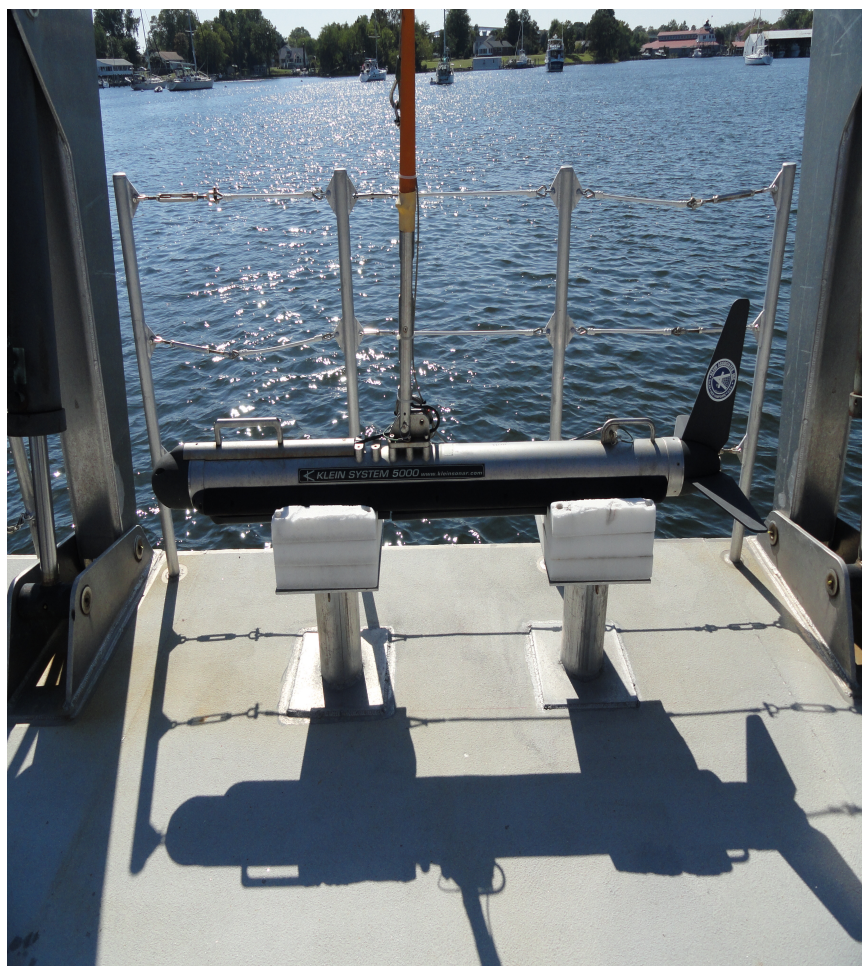


Figure 2: Klein 5500 light weight towfish

A.2.2 Multibeam Echosounders

A.2.2.1 RESON SeaBat 7125

<i>Manufacturer</i>	RESON
<i>Model</i>	SeaBat 7125
<i>Description</i>	The RESON SeaBat 7125 system is a single-frequency, digital recording Multibeam echosounder, which is pole mounted on retractable arm. The integrated system includes a 400 kHz Projector unit, a Receiver unit, a Link Control Unit (LCU), and a topside 7-P Sonar Processor Unit (TPU). The projector and receiver are set up in a Mills Cross configuration, and the pole arm is deployed through a bomb bay door located on the center line of the vessel. 0.. The Seabat 7125 produces a 128°

	<p>across track swath, that is resolved into 512 discrete equidistance beams by the receive array. Each beam has a resolution of 1.0° along track, and 0.5° across track. Sound velocity at the face of the transducer is provided by an integrated ODOM Hydrographic Systems Digibar Pro sound velocimeter. This system will be discussed in further detail in the Sound Velocity Equipment Section. Ping rate, range, power, gain and pulse width all varied with the depth of the area being surveyed. The 7-P Sonar Processor Unit has the following software versions installed: 7K Center: Version 3.7.7.9 7K IO: Version: 3.4.1.11 7K UI: Version 3.12.5.8 Bathymetric data from the RESON 7125 is used to provide object detection in shallow water.</p>		
<i>Serial Numbers</i>	<i>Vessel Installed On</i>	5401	
	<i>Processor s/n</i>	2708006	
	<i>Transceiver s/n</i>	none	
	<i>Transducer s/n</i>	51515	
	<i>Receiver s/n</i>	0808037	
	<i>Projector 1 s/n</i>	0908167	
	<i>Projector 2 s/n</i>	None	
<i>Specifications</i>	<i>Frequency</i>	400 kilohertz	
	<i>Beamwidth</i>	<i>Along Track</i>	1.0 degrees
		<i>Across Track</i>	0.5 degrees
	<i>Max Ping Rate</i>	50 hertz	
	<i>Beam Spacing</i>	<i>Beam Spacing Mode</i>	Equidistant
		<i>Number of Beams</i>	512
	<i>Max Swath Width</i>	128 degrees	
	<i>Depth Resolution</i>	0.003 meters	
	<i>Depth Rating</i>	<i>Manufacturer Specified</i>	50 meters
		<i>Ship Usage</i>	38 meters
<i>Manufacturer Calibrations</i>	Manufacturer calibration was not performed.		
<i>System Accuracy Tests</i>			

	<i>Vessel Installed On</i>	S5401	S5401
	<i>Methods</i>	Comparison to Vertical Beam Echosounder	Patch Test
	<i>Results</i>	On 4 Jan 2011, soundings from the RESON SeaBat 7125 were compared to soundings from the ODOM Vertical Beam Echosounder. The average difference between depths was 4mm.	On 31 Jan 2011 the MBES system was patch tested, in order to resolve residual biases between the sonar reference frame, and the positioning system reference frame. On 9 May 2011 the vessel's positioning system was replaced, and the 7125 was re-patched.
<i>Snippets</i>	Sonar has snippets logging capability.		



Figure 3: Mills cross multibeam projector and receiver configuration on retractable arm

A.2.3 Single Beam Echosounders

A.2.3.1 ODOM Echotrac CV 200 Vertical Beam Echosounder CV-200

<i>Manufacturer</i>	ODOM Echotrac CV 200 Vertical Beam Echosounder					
<i>Model</i>	CV-200					
<i>Description</i>	The Odom Echotrac CV-200 is a dual frequency digital recording echosounder, mounted to the starboard pontoon of the R/V bay Hydro II.					
<i>Serial Numbers</i>	<i>Vessel</i>	5401				
	<i>Processor s/n</i>	003071				
	<i>Transducer s/n</i>	TR5444				
<i>Specifications</i>	<i>Frequency</i>	200 hertz			24 kilohertz	
	<i>Beamwidth</i>	<i>Along Track</i>	10 degrees		<i>Along Track</i>	10 degrees
		<i>Across Track</i>	12 degrees		<i>Across Track</i>	12 degrees
	<i>Max Ping Rate</i>	20 hertz			20 hertz	
	<i>Depth Resolution</i>	0.01 meters			0.01 meters	
	<i>Depth Rating</i>	<i>Manufacturer Specified</i>	1220 meters		<i>Manufacturer Specified</i>	1220 meters
		<i>Ship Usage</i>	38 meters		<i>Ship Usage</i>	38 meters
<i>Manufacturer Calibrations</i>	Manufacturer calibration was not performed.					
<i>System Accuracy Tests</i>						
	<i>Vessel Installed On</i>	S5401				
	<i>Methods</i>	Comparison to Lead Line				
	<i>Results</i>	On 4 Jan 2011, soundings from the ODOM Vertical Beam Echosounder were compared to soundings read off a leadline. The average difference between depths was 4mm.				



Figure 4: Starboard VBES Sonar

A.2.4 Phase Measuring Bathymetric Sonars

No phase measuring bathymetric sonars were utilized for data acquisition.

A.2.5 Other Echosounders

No other echosounders were utilized for data acquisition.

A.3 Manual Sounding Equipment

A.3.1 Diver Depth Gauges

No diver depth gauges were utilized for data acquisition.

A.3.2 Lead Lines

Manufacturer	N/A	
Model	N/A	
Description	The R/V Bay Hydro II is equipped with a non-traditional lead-line fabricated from Amsteel® brand line and an eight inch tall mushroom anchor. This lead line was newly fabricated on 16 June 2009 by LT Michael C. Davidson, and re-calibrated on 4 Jan 2011.	
Serial Numbers	N/A	
Calibrations	<i>Serial Number</i>	N/A
	<i>Date</i>	2011-01-04
	<i>Procedures</i>	The 8lbs mushroom anchor was removed, and replaced with an in-line scale. The line was then pulled taut until a force of 8lbs registered on the in line scale. The graduations were then checked using a steel measuring tape. Performed 4 Jan 2011 (DN 004). For a complete report, refer to Appendix 2 of this DAPR.
Accuracy Checks	<i>Serial Number</i>	none
	<i>Date</i>	2010-03-17
	<i>Procedures</i>	On 4 Jan 2011, soundings from the leadline was compared to soundings from the ODOM Vertical Beam Echosounder. The average difference between depths was 4mm. For a complete report, refer to Appendix 2 of this DAPR.
Correctors	Correctors were not determined.	
Non-Standard Procedures	Non-standard procedures were not utilized.	



Figure 5: Leadline with mushroom anchor

A.3.3 Sounding Poles

No diver depth gauges were utilized for data acquisition.

A.3.4 Other Manual Sounding Equipment

No diver depth gauges were utilized for data acquisition.

A.4 Positioning and Attitude Equipment

A.4.1 Applanix POS/MV

Manufacturer	Applanix (a Trimble company)
--------------	------------------------------

Model	v.4		
Description	The POS M/V is a GPS-aided inertial positioning system that provides position and orientation data to external equipment. It is composed of an Inertial Measurement Unit, two GNSS receivers, and a POS Computing System (PCS) unit. Roll, pitch, and heave values are measured by the Inertial Measurement Unit (IMU). Position is derived from the tightly-coupled GPS/IMU integration. Heading is determined by blending data from the GNSS antennas, with heading estimates from the IMU.		
PCS	<i>Manufacturer</i>	Applanix (a Trimble company)	
	<i>Model</i>	v.4	
	<i>Description</i>	The PCS blends raw acceleration measurements from the IMU, with positional information from the GPS antennas and RTCM beacon, creating a tightly-coupled position and orientation solution. The PCS also provides the one Pulse Per Second (PPS) signal used by integrated systems to accurately time-stamp data.	
	<i>Firmware Version</i>	4.1-7	
	<i>Software Version</i>	3.4.0.0	
	<i>Serial Numbers</i>	<i>Vessel Installed On</i>	5401
		<i>PCS s/n</i>	3954
IMU			

	<i>Manufacturer</i>	Applanix (a Trimble company)		
	<i>Model</i>	v4		
	<i>Description</i>	The POS M/V Inertial Measurement Unit (IMU) is used to record the amount of heave, pitch, and roll experienced by the vessel. The Unit is located at the vessel's central reference point, and is strapped down to the vessel. Since the IMU is fixed to the vessel, the motion experienced by the IMU is, by definition, the same motion experienced by the vessel. The IMU housing contains three orthogonally placed accelerometers, which sense acceleration in the x, y, and z directions. It also contains three orthogonally placed gyros, which sense angular rate of motion around the three axis. The measured amount of acceleration and rate of rotation is then used to find the degree of pitch, roll, and heave experienced by the vessel. Data from the IMU is also combined with data from the GNSS antennas to calculate vessel heading. For further discussion, refer to the Antenna section of this report.		
	<i>Serial Numbers</i>	<i>Vessel Installed On</i>	5401	
		<i>IMU s/n</i>	1023	
	<i>Certification</i>	IMU certification report was not produced.		
Antennas	<i>Manufacturer</i>	Applanix (A Trimble Company)		
	<i>Model</i>	Zephyr Model 2		
	<i>Description</i>	The POS M/V system includes two GNSS antennas, each of which provides carrier phase level positioning information. In addition to providing robust positional information, the antenna's level of accuracy is also used to improve the system's heading accuracy. By using carrier phase level positioning, the system has enough resolution to position one antenna relative to the other. The positions are then used to calculate the North-East-Down vector between the Primary and the Secondary antennas. Combining the North-East-Down vector with the measured distance between antennas allows the system to resolve the IMU's heading. These heading estimates are blended with heading estimates made by the IMU, providing an extremely accurate heading solution.		
	<i>Serial Numbers</i>	<i>Vessel Installed On</i>	S5401	S5401
		<i>Antenna s/n</i>	1440911819	1440918106
<i>Port or Starboard</i>		Port	Starboard	
<i>Primary or Secondary</i>		Primary	Secondary	

GAMS Calibration	<i>Vessel</i>	5401
	<i>Calibration Date</i>	2011-01-04
Configuration Reports	POS/MV configuration reports were not produced.	



Figure 6: POS MV Topside Unit

A.4.2 DGPS

<i>Description</i>	Trimble
--------------------	---------

<i>Antennas</i>	<i>Manufacturer</i>	Trimble	
	<i>Model</i>	27207-00	
	<i>Description</i>	This combined antenna features two elements, a L1 GPS antenna and a Beacon H-Field Loop antenna. The L1 GPS antenna is an active antenna element that filters out unwanted signals and amplifies the L1 signal. The Beacon H-field Loop antenna works as a preamplifier for filtering out interference and amplifies the Beacon signal.	
	<i>Serial Numbers</i>	<i>Vessel Installed On</i>	S5401
		<i>Antenna s/n</i>	0220172421
<i>Receivers</i>	<i>Manufacturer</i>	Trimble	
	<i>Model</i>	DSM212L	
	<i>Description</i>	This DGPS receiver allows for submeter vessel positioning during hydrographic survey.	
	<i>Firmware Version</i>	1.32 242.11	
	<i>Serial Numbers</i>	<i>Vessel Installed On</i>	5401
		<i>Antenna s/n</i>	0220177299

A.4.3 Trimble Backpacks

<i>Manufacturer</i>	Trimble
<i>Model</i>	GeoExplorer 2008 Series GeoXH
<i>Description</i>	Product # 70950-00 Used to collect geographic positions and detached positions for acquiring position for assigned shoreline features. The handheld has submeter GPS receiver combined with rugged handheld computer. 520 MHz processor, 128 MB RAM, and 1 GB of onboard storage with a high resolution VGA, long lasting battery Powered by industry-standard Windows Mobile version 6 operating system. Data is then reviewed and exported for position products through Pathfinder Office. The handheld has LAN or bluetooth wireless connection functionality.
<i>Serial Numbers</i>	4713435892
<i>Antennas</i>	No antennas were installed.
<i>Receivers</i>	No receivers were installed.
<i>Field Computers</i>	No field computers were utilized for data acquisition.

<i>DQA Tests</i>	DQA test was not performed.
------------------	-----------------------------



Figure 7: Handheld GeoXH

A.4.4 Laser Rangefinders

<i>Manufacturer</i>	Laser Technology Inc
<i>Model</i>	Impulse
<i>Description</i>	Light weight, hand-held laser range instrument that allows you to quickly and conveniently measure distances, heights, and vertical angles. The Impulse uses sensors to measure distances and vertical angles, and menu-driven software to convert sensor readings to meaningful measurements.

<i>Serial Numbers</i>	ii08463
<i>DQA Tests</i>	DQA test was not performed.



Figure 8: Impulse laser rangefinder

A.4.5 Other Positioning and Attitude Equipment

No additional positioning and attitude equipment was utilized for data acquisition.

A.5 Sound Speed Equipment

A.5.1 Sound Speed Profiles

A.5.1.1 CTD Profilers

A.5.1.1.1 Sea-Bird Electronics CTD SBE 19 Plus 05M

<i>Manufacturer</i>	Sea-Bird Electronics CTD	
<i>Model</i>	SBE 19 Plus 05M	
<i>Description</i>	The R/V Bay Hydro II uses a Sea-Bird Electronics SeaCat SBE19+ Conductivity, Temperature, and Depth (CTD) profiler to collect sound velocity profiles. Temperature is measured directly. Salinity is calculated from measured electrical conductivity. Depth is calculated from strain gauge pressure.	
<i>Serial Numbers</i>	<i>Vessel Installed On</i>	S5401
	<i>CTD s/n</i>	19P37217-4677
<i>Calibrations</i>	<i>CTD s/n</i>	19P37217-4677
	<i>Date</i>	2010-12-27
	<i>Procedures</i>	Calibration performed by SEABIRD Electronics



Figure 9: CTD SBE 19 Plus

A.5.1.2 Sound Speed Profilers

A.5.1.2.1 SeaBird Electronics, Inc. 19plus

<i>Manufacturer</i>	SeaBird Electronics, Inc.
<i>Model</i>	19plus
<i>Description</i>	The R/V BAY HYDRO II uses a Sea-Bird Electronics SeaCat SBE19plus. Conductivity, temperature, and depth (CTD) profiler to collect sound velocity profiles. Temperature is measured directly, while salinity is calculated from measured electrical conductivity and depth is calculated from strain gauge pressure. CTP casts

	are processed using HSTP's Velocipy software, and applied to SWMB and VBES data using Caris HIPS..	
<i>Serial Numbers</i>		
	<i>Vessel Installed On</i>	S5401
	<i>Sound Speed Profiler s/n</i>	19P37217-4677
<i>Calibrations</i>	<i>Sound Speed Profiler s/n</i>	19P37217-4677
	<i>Date</i>	2011-05-23
	<i>Procedures</i>	Calibration performed by manufacturer.

A.5.2 Surface Sound Speed

A.5.2.1 DIGIBAR PRO 1.12

<i>Manufacturer</i>	DIGIBAR PRO	
<i>Model</i>	1.12	
<i>Description</i>	The Digibar Pro is a sing-around transducer, measuring the speed of sound in water by finding the time needed for a ping of sound to travel a known distance.	
<i>Serial Numbers</i>	<i>Vessel Installed On</i>	S5401
	<i>Sound Speed Sensor s/n</i>	98376-121610
<i>Calibrations</i>	<i>Sound Speed Sensor s/n</i>	98376-121610
	<i>Date</i>	2010-12-16
	<i>Procedures</i>	Performed by Teledyne ODOM



Figure 10: Digibar Pro 19+

A.6 Horizontal and Vertical Control Equipment

A.6.1 Horizontal Control Equipment

No horizontal control equipment was utilized for data acquisition.

A.6.2 Vertical Control Equipment

No vertical control equipment was utilized for data acquisition.

A.7 Computer Hardware and Software

A.7.1 Computer Hardware

<i>Manufacturer</i>	Dell	
<i>Model</i>	Precision T3400	
<i>Description</i>	Hypack Computer using an Intel Core2 Quad CPU Q6700 that processes at 2.66 GHz and has 3 GB of RAM. This computer is used to operate the HyPack/HySweep interface, as well as to view the POS M/V interface during acquisition.	
<i>Serial Numbers</i>	<i>Computer s/n</i>	7FH43H1
	<i>Operating System</i>	Microsoft Windows XP Professional, Version 2002 Service Pack 3
	<i>Use</i>	Acquisition
<i>Manufacturer</i>	Dell	
<i>Model</i>	Precision T3400	
<i>Description</i>	Sonar Pro Computer (OCS-W-NSD716681) using an Intel Core2 Quad CPU Q6600 that processes at 2.40 GHz and has 3.25 GB of RAM. This computer is used for the SonarPro interface.	
<i>Serial Numbers</i>	<i>Computer s/n</i>	4HJRTK1
	<i>Operating System</i>	Microsoft Windows XP Professional, Version 2002 Service Pack 3
	<i>Use</i>	Acquisition
<i>Manufacturer</i>	Dell	
<i>Model</i>	Precision T3500	
<i>Description</i>	Processing Computer II (OCS-W-NSD765279) uses an Intel Xeon CPU that processes at 3.00GHz and has 3.00GB of RAM. This computer is used for post-processing and development of deliverables, using the following programs: CARIS HIPS/SIPS, CARIS Bathy DataBase , Pydro, Velocipy, and the full Microsoft Office Suite.	
<i>Serial Numbers</i>	<i>Computer s/n</i>	6T209K1
	<i>Operating System</i>	Microsoft Windows XP Professional, Version 2002 Service Pack 3
	<i>Use</i>	Processing
<i>Manufacturer</i>	Dell	
<i>Model</i>	Precision 490	
<i>Description</i>	Processing Computer 1 uses an Intel Xeon CPU that processes at 3.00GHZ and has 3.00GB of RAM. This computer is used for post-processing and development of	

	deliverables only, using the following programs: CARIS HIPS/SIPS, CARIS Bathy DataBASE, Pydro, Velocipy, and the full Microsoft Office Suite.	
<i>Serial Numbers</i>	<i>Computer s/n</i>	GGROTBI
	<i>Operating System</i>	Microsoft Windows XP Professional, Version 2002 Service Pack 3
	<i>Use</i>	Processing

A.7.2 Computer Software

<i>Manufacturer</i>	HYPACK, Inc
<i>Software Name</i>	Hypack 2011
<i>Version</i>	11.0.1.54
<i>Service Pack</i>	none
<i>Hotfix</i>	none
<i>Installation Date</i>	2010-01-04
<i>Use</i>	Acquisition
<i>Description</i>	HYPACK Hypack is used to acquire VBES data in a *.raw format, and detached positions, in a *.tgt format. It is also used for vessel navigation during data acquisition. HYSWEEP Hysweep is a module for Hypack used to acquire RESON 7125 MBES data in a *.HSX format. It receives input from The Reson 7125, the Digibar Pro, and the Applanix POS/MV systems.
<i>Manufacturer</i>	Applanix
<i>Software Name</i>	POSVIEW
<i>Version</i>	5.1.0.2
<i>Service Pack</i>	none
<i>Hotfix</i>	none
<i>Installation Date</i>	2011-05-05
<i>Use</i>	Acquisition
<i>Description</i>	POSVIEW is used to monitor positional accuracy and log positional and inertial data while displaying the attitude accuracy details
<i>Manufacturer</i>	Applanix
<i>Software Name</i>	MMS
<i>Version</i>	5.3.3838.25021
<i>Service Pack</i>	3
<i>Hotfix</i>	none
<i>Installation Date</i>	2010-01-05

<i>Use</i>	Processing
<i>Description</i>	POSPac MMS is used to process POSPac files, which are recorded in a .000 format.
<i>Manufacturer</i>	Caris
<i>Software Name</i>	HIPS and SIPS
<i>Version</i>	7.1
<i>Service Pack</i>	2
<i>Hotfix</i>	7
<i>Installation Date</i>	2010-01-05
<i>Use</i>	Processing
<i>Description</i>	CARIS HIPS (Hydrographic Information Processing System) is used for the initial processing of Multibeam echosounder data. The program applies vessel offsets to the raw sonar data, corrects for tide and sound velocity, and calculates a Total Propagated Uncertainty (TPU) for each sounding. Individual soundings are then processed into CUBE (Combined Uncertainty and Bathymetry Estimator) grids. CARIS SIPS (Side-Scan Information Processing System) is used for processing of side-scan sonar imagery, including cable layback correction, slant range correction, contact selection, tow point entry, and mosaic generation.
<i>Manufacturer</i>	NOAA OCS HSTP
<i>Software Name</i>	PYDRO
<i>Version</i>	v11.3
<i>Service Pack</i>	r3347
<i>Hotfix</i>	
<i>Installation Date</i>	2011-05-05
<i>Use</i>	Processing
<i>Description</i>	HSTP PYDRO is a program for the classification of side-scan sonar and Multibeam bathymetry contacts, and for the creation of preliminary smooth sheets. Multibeam contacts (designated soundings), side-scan sonar contacts, and detached position contacts are analyzed, grouped, and assigned S-57 classifications. The bathymetric grid is imported for comparison between surveyed and charted depths, and to the side scan contacts. The sounding selection interval is dependent on the survey scale. The final product is a Preliminary Smooth Sheet file (PSS), which is delivered to the Atlantic Hydrographic Branch as part of the final submission package. PYDRO is also used for chart comparisons, generation of chartlets, generation of Danger to Navigation reports, generation of appendices to the Descriptive Report, compilation of survey statistics, and generation of standard NOAA forms such as the Descriptive Report cover sheet.
<i>Manufacturer</i>	NOAA OCS HSTP
<i>Software Name</i>	VELOCIPY
<i>Version</i>	v11.3

<i>Service Pack</i>	
<i>Hotfix</i>	
<i>Installation Date</i>	2011-05-05
<i>Use</i>	Processing
<i>Description</i>	HSTP VELOCIPY is a program used for processing sound velocity casts. This program converts the hexadecimal SeaCat data into ASCII data, then converts the ASCII data into a depth-binned sound velocity file. The resulting .svp files are applied to MBES and VBES data during post processing to correct for sound velocity variation within the water column
<i>Manufacturer</i>	PitneyBowes
<i>Software Name</i>	MAPINFO Professional
<i>Version</i>	10
<i>Service Pack</i>	
<i>Hotfix</i>	
<i>Installation Date</i>	2011-05-05
<i>Use</i>	Acquisition
<i>Description</i>	MapInfo is the Geographic Information System (GIS) software package used to plan survey lines, review hydrographic data, and create preliminary chartlet plots. HYDRO_MI is a OCS HSTP product and exists as a set of tools that aid hydrographic acquisition planning.

A.8 Bottom Sampling Equipment

A.8.1 Bottom Samplers

A.8.1.1 Unknown Unknown

<i>Manufacturer</i>	Unknown
<i>Model</i>	Unknown
<i>Description</i>	Ponar-type grab sampler is used to verify assigned charted seafloor bottom type

B Quality Control

B.1 Data Acquisition

B.1.1 Bathymetry

B.1.1.1 Multibeam Echosounder

All Multibeam data is logged using Hypack Hysweep in the .HSX format. During acquisition, the hydrographer: · Monitors the Reson SeaBat interface for errors and data quality; · Adjusts range scale, power, gain, pulse width, swath width, absorption, spreading, and gates to ensure maximum data quality; · Monitors the Hysweep interface using the following sub-windows: 3-D sounding points, Multibeam Waterfall-Solid TIN, and Profile Window-Beam Pattern; · Monitors vessel speed and adjusted as necessary to ensure density specifications.

B.1.1.2 Single Beam Echosounder

All Vertical Beam Data is logged using Hypack Hysweep in the .bin and .RAW formats. During acquisition, the hydrographer: · Monitors real-time data in Odom's eChart interface; · Adjusts gain and power as needed to ensure data quality.

B.1.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not acquired.

B.1.2 Imagery

B.1.2.1 Side Scan Sonar

All Side Scan Sonar data is logged using Klein SonarPro, in the .SDF format. During acquisition, the hydrographer: · Monitors: range, fish height, heading, pitch, roll, latitude, longitude, speed, pressure, and temperature; · Adjust towfish height, in accordance with Field Procedures Manual, and manually record in Sonar Pro.

B.1.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not acquired.

B.1.3 Sound Speed

B.1.3.1 Sound Speed Profiles

Sound velocity profiles are taken once per week for VBES acquisition, and once every 2 - 4 hours for MBES. All casts are taken by hand. Profiles are collected more frequently when transiting more than 1 nautical mile between survey areas, or when current and weather conditions warrant. Sound velocity casts are applied to all bathymetric data during post processing. The Sea-Bird CTD is sent for factory calibration annually. Calibration Reports can be found in Separate II of this report.



Figure 11: Sound Speed Profiling Device

B.1.3.2 Surface Sound Speed

Sound speed values at the transducer face are applied real-time. Accuracy of the transducer is checked against the data point closest to the transducer depth on every CTD cast. The Sea-Bird CTD is sent for factory calibration annually. Calibration Reports can be found in Separate II of this report.

B.1.4 Horizontal and Vertical Control

B.1.4.1 Horizontal Control

The Bay Hydro II uses DGPS to establish horizontal position, using an assigned U.S. Coast Guard Maritime DGPS Services beacon. The frequency of the assigned beacon is programmed into the Trimble DGPS receiver using the program TSIP Talker. The minimum number of satellites, their minimum elevation above the horizon, and the age of pseudo range corrects are also set in TSIPs Talker. During acquisition, differential correctors are sent to the Applanix POS M/V via serial connection. Total positional accuracy is then monitored inside the MV-POSView window.

B.1.4.2 Vertical Control

During data acquisition, bathymetric data is initially reduced to Mean Lower-Low Water (MLLW) using preliminary (observed) water level data. Water level stations and zone files, or TCARI grids, are assigned by the Center for Operational Oceanographic Products and Services (CO-OPS). Preliminary water levels are downloaded through the CO-OPS website in six-minute intervals and applied to the data at the end of each day. After acquisition is complete, preliminary tide levels and zoning are examined for veracity by CO-OPS, and all bathymetric data is then re-reduced to the verified levels.

B.1.5 Feature Verification

The following work flow is used to develop features:

- The locations of all potentially significant features are exported to MapInfo. Any indication of shoaling found in the VBES data is also noted, and the area outlined in MapInfo;
- A development line plan is created using MapInfo, creating line spacing that will encompass all features with nadir beams;
- Object Detection level MBES data is collected over all SSS contacts, VBES designated soundings, and all possible shoals. Quality of data is controlled through:
- Real time monitoring during acquisition to ensure that all features are covered by nadir beams;
- Post Processing inspection of the CUBE surface's Density and Uncertainty layers;
- All developments are examined for significance. Objects found to be significant are flagged with a designated sounding, and imported into HSTP Pydro for reporting.

B.1.6 Bottom Sampling

Bottom Samples are collected according to the sample diagram contained in the Project Instructions. A Van veen grab sampler is used to take samples.

B.1.7 Backscatter

Backscatter data were not acquired.

B.1.8 Other

No additional data were acquired.

B.2 Data Processing

B.2.1 Bathymetry

B.2.1.1 Multibeam Echosounder

Convert MBES data using CARIS HIPS, · Apply True Heave; correct for tide and speed of sound; compute Total Propagated Error · Uncertainty values in the HVF follow recommendations of FPM, Appendix 4, · With the exception of MRU alignment uncertainties, which are calculated using the standard deviation of all angular biases found during a patch test; · For tidal zoning and speed of sound error modeling, refer to section B.2.2 of the Descriptive Report; · Scan Navigation and Attitude data, flagging erroneous data as rejected; · Initial data cleaning using Swath Editor to reject gross flyers; · Create CUBE grids. Grid resolution is dictated by the type of coverage required (Complete Coverage vs. Object Detection) and the depth of the water. Disambiguation method is NOAA Cube Parameters 2010. Compliance with HSSD gridding requirements is strictly observed, · Review the CUBE grids for holidays; · Create an initial holiday line plan; · Review the uncertainty layer of the each CUBE grid. Address each area where uncertainty falls outside of the standards set by HSSD; · Review the density layer of each CUBE grid for compliance with HSSD specified density requirements, · Add areas of rarefaction to the holiday line plan; · Examine all surfaces for erroneous surface designation and evidence of systematic errors, for features, and for evidence shoaling, · Significant features are flagged ‘designated’, forcing the CUBE algorithm honor the depth of the sounding

I

1

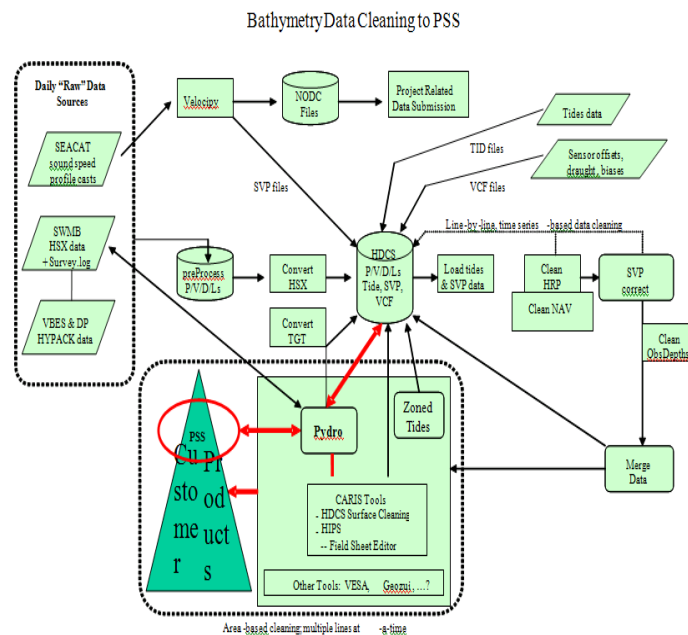


Figure 12: Bathymetry Data Cleaning to PSS

B.2.1.2 Single Beam Echosounder

VBES Data · Convert VBES data using CARIS HIPS; · Scan Navigation and Attitude data, flagging erroneous data as rejected; · Apply tide and speed of sound corrections, compute Total Propagated Uncertainty Uncertainty values in the HVF follow recommendations of NOAA Field Procedures Manual (FPM), Appendix 4, · With the exception of MRU alignment uncertainties, which are calculated using the standard deviation of all angular biases found during a patch test; · For tidal zoning and speed of sound error modeling, refer to section B.2.2 of the Descriptive Report; · Clean data using CARIS Single Beam Editor, flagging data from the water column and sub-bottom returns as rejected; · When definition of the true bottom is ambiguous, the full water column data can be inspected by viewing the HYPACK created .bin files; · Create CARIS BASE Uncertainty Weighted Grids at 4 meter resolution; · Analyze grids for features and for areas of shoaling; flag for development by a Multibeam sonar.

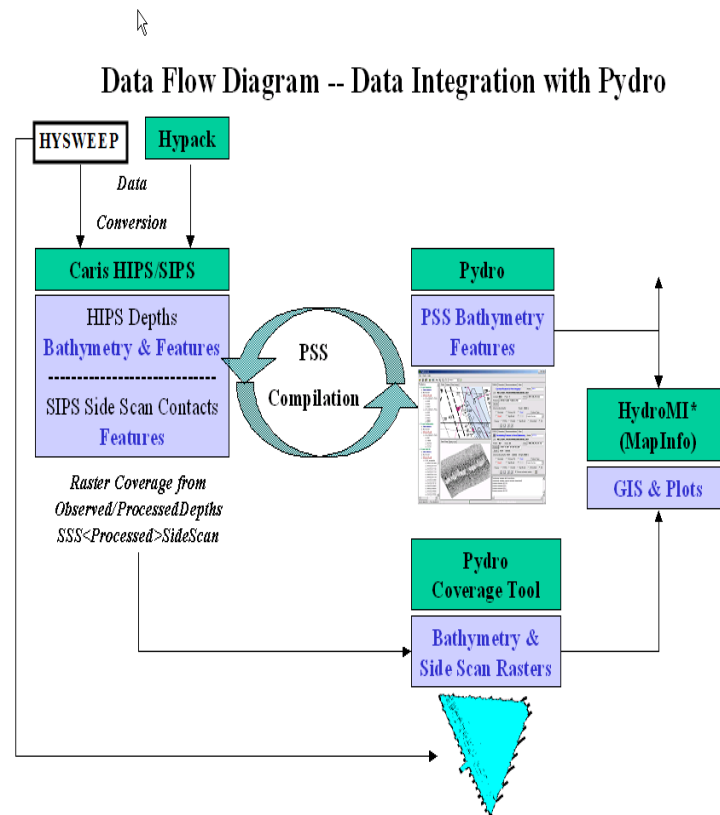


Figure 13: Data Flow Diagram

B.2.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not processed.

B.2.1.4 Specific Data Processing Methods

B.2.1.4.1 Methods Used to Maintain Data Integrity

B.2.1.4.2 Methods Used to Generate Bathymetric Grids

B.2.1.4.3 Methods Used to Derive Final Depths

<i>Methods Used</i>	
---------------------	--

B.2.2 Imagery

B.2.2.1 Side Scan Sonar

SSS Data · Convert SSS data using CARIS SIPS; · Scan Navigation and Attitude data, flagging erroneous data as rejected; · Re-Compute towfish navigation. This is when tow point offsets and horizontal layback is applied to the data; · Slant Range correct each line of data; · A primary reviewer scans each line for significant contacts, · A secondary reviewer makes an independent check-scan of all lines, verifying contacts and checking for missed contacts; · If the Project Instructions call for 200% Side Scan coverage, the scanners check for correlation of contacts between 100% and 200% coverage; · Correlation is also used to reveal systematic errors, particularly if a contact shows up on lines collected in opposite or orthogonal directions; · Create individual mosaics for 100% and 200% coverage. Examine for coverage, · If necessary, create a holiday line plan.

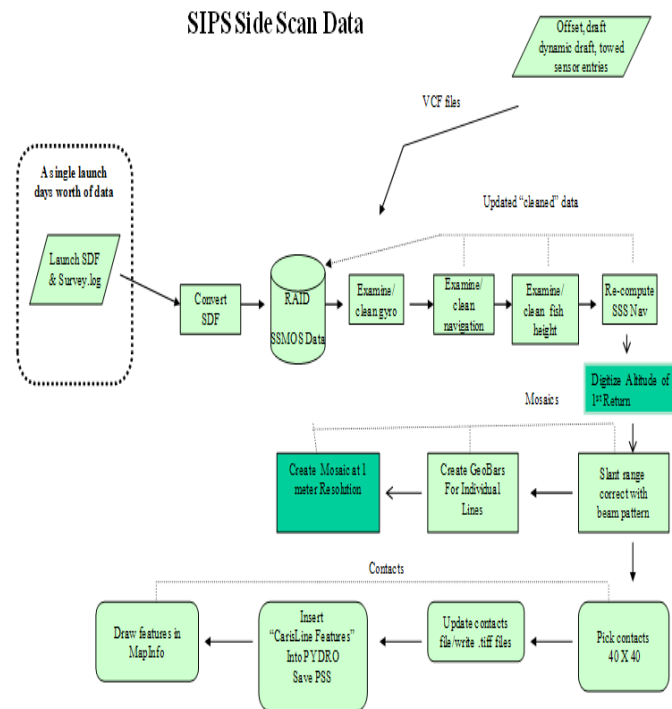


Figure 14: Side Scan Sonar Workflow

B.2.2.2 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not processed.

B.2.2.3 Specific Data Processing Methods

B.2.2.3.1 Methods Used to Maintain Data Integrity

Daily confidence checks were completed to insure integrity of data. These checks were completed by ensonifying a target in the outer limits of the range scale on either side of towfish. When this target was seen on the trace within ten meters of the targets actual position (the positional accuracy of a towed system), it was understood that data integrity was maintained.

B.2.2.3.2 Methods Used to Achieve Object Detection and Accuracy Requirements

R/V BAY HYDRO II achieved object detection and accuracy requirements by limiting vessel speed to insure that a minimum of three independent pings occurred per meter traveled in the along track direction, as well as by insuring the towfish was positioned between eight and twenty of the range scale off of the bottom.

B.2.2.3.3 Methods Used to Verify Swath Coverage

Mosaics were created after SSS acquisition was completed. These mosaics were placed onto a brightly colored background in the CARIS window so that holidays were easily visible. If holidays were found to exist, a new line plan was created to address them.

B.2.2.3.4 Criteria Used for Contact Selection

R/V BAY HYDRO II followed the contact height of one meter in twenty meter water depth criteria as set forth in the HSSD section 6.3.2.

B.2.2.3.5 Compression Methods Used for Reviewing Imagery

No compression methods were used for reviewing imagery.

B.2.3 Sound Speed

B.2.3.1 Sound Speed Profiles

Sound speed profiles were acquired with a SeaBird Electronics SeaCat SBE19plus profiler. Raw conductivity, temperature, and pressure data were processed using Velocipy, which generates sound speed profiles utilized by CARIS HIPS/SIPS. Sound speed correctors were applied to SWMB and VBES sounding in CARIS HIPS during post processing. The speed of sound through the water column was determined by a minimum of one cast every 2-4 hours of MBES acquisition, and one cast every week for VBES acquisition.

B.2.3.1.1 Specific Data Processing Methods

B.2.3.1.1.1 Caris SVP File Concatenation Methods

A project specific concatenated SVP file is created using Velocipy.

Figure 15: H12321 SVP Files

B.2.3.2 Surface Sound Speed

Surface sound speed data were not processed.

B.2.4 Horizontal and Vertical Control

B.2.4.1 Horizontal Control

Position accuracy and quality were monitored in real time using the MV-POSView Controller software to ensure positioning accuracy requirements in the NOS Hydrographic Surveys Specifications and Deliverables were met.

Figure 16: Real Time HORCON Monitoring Interface

B.2.4.2 Vertical Control

Heave accuracy and quality were monitored in real time using the MV-POSView Controller software to ensure positioning accuracy requirements in the NOS Hydrographic Surveys Specifications and Deliverables were met. Water level control were provided by CO-OPS.

Figure 17: Real Time Vertical Control Monitoring Interface

B.2.5 Feature Verification

Features were verified using MBES. Shoreline features were collected using detached positions. The vessel's position was recorded using Hypack, and the range to the object found using a laser range finder. Position, range, and azimuth were then input into Pydro.

Figure 18:

B.2.6 Backscatter

Backscatter data were not processed.

B.2.7 Other

No additional data were processed.

B.3 Quality Management

Prior to each Field Season the R/V Bay Hydro II performs an Annual Systems Preparation, during which all Multibeam sonars, Side Scan Sonars, lead lines, sound speed measuring devices, and positioning systems are calibrated. Additionally, a comparison is made between depths found by lead line, VBES, and the MBES.

During daily acquisition, a hydrographer monitors the cumulative uncertainties in position and attitude data, watches incoming data for errors, and compares the surface sound speed against full water column data for each CTD cast. During post processing, Navigation and Attitude data is scanned using Caris HIPS & SIPS. Side Scan data is then scanned for significant features by two separate individuals. Multibeam data is binned into a BASE surface using the CUBE algorithm, then undergoes directed editing using the Standard Deviation, Depth, Uncertainty, and Hypothesis Count child layers. The Uncertainty layer is also used to ensure the data complies with IHO uncertainty standards.

B.4 Uncertainty and Error Management

TPU is computed for each sounding using the CUBE algorithm, using the NOAA specified CubeParams_2010 values. TPU for sound speed is set to 2 m/s for Measured, and is generally set to 0.20 m/s for Surface. However, if the hydrographer observes a significant halocline near the depth of the multibeam head, Surface TPU can be increased up to 2 m/s.

B.4.1 Total Propagated Uncertainty (TPU)

B.4.1.1 TPU Calculation Methods

TPU is computed using the CUBE algorithm in CARIS HIPS. The contributing estimates are pulled from Appendix IV of the Field Procedures Manual, with the exception of MRU alignment. Those values are estimated by calculating the standard deviation of a large sample of angular bias values resolved with a patch test.

B.4.1.2 Source of TPU Values

Field Procedures Manual: Appendix IV

B.4.1.3 TPU Values

<i>Vessel</i>	R/V BAY HYDRO II		
<i>Echosounder</i>	Reson SeaBat 7125 400 kilohertz		
<i>TPU Standard Deviation Values</i>	<i>Motion</i>	<i>Gyro</i>	0.020 degrees
		<i>Heave</i>	5.0 % Amplitude
			0.050 meters
		<i>Pitch</i>	0.020 degrees
		<i>Roll</i>	0.020 degrees

	<i>Navigation Position</i>	1.0 meters	
	<i>Timing</i>	<i>Transducer</i>	0.005 seconds
		<i>Navigation</i>	0.005 seconds
		<i>Gyro</i>	0.005 seconds
		<i>Heave</i>	0.005 seconds
		<i>Pitch</i>	0.005 seconds
		<i>Roll</i>	0.005 seconds
	<i>Offsets</i>	<i>x</i>	0.002 meters
		<i>y</i>	0.002 meters
		<i>z</i>	0.002 meters
	<i>MRU Alignment</i>	<i>Gyro</i>	0.000 degrees
		<i>Pitch</i>	0.000 degrees
		<i>Roll</i>	0.000 degrees
	<i>Vessel</i>	<i>Speed</i>	0.257 meters/second
		<i>Loading</i>	0.100 meters
		<i>Draft</i>	0.020 meters
		<i>Delta Draft</i>	0.020 meters

B.4.2 Deviations

There were no deviations from the requirement to compute total propagated uncertainty.

C Corrections To Echo Soundings

C.1 Vessel Offsets and Layback

C.1.1 Vessel Offsets

C.1.1.1 Description of Correctors

An NGS survey of R/V BAY HYDRO II was performed on 23 March 2009 using optical levels. The survey established the vessel's Reference Point (RP), then found the X, Y, and Z distances for the GNSS antennas and multibeam sonar. On 26 February 2010 the crew surveyed in the Tow

Point for the side scan sonar. On 18 March 2010 the crew surveyed in the vessel's singlebeam transducers.

C.1.1.2 Methods and Procedures

This original Sensor Components Spatial Relationship Survey was conducted using the TOPCON GPT 3002LW Series Total Station, and a SECO 25mm Mini Prism System. The vessel's Tow Point was established using a laser level and measuring tape. The singlebeam transducers were also surveyed using a level and measuring tape.

C.1.1.3 Vessel Offset Correctors

Vessel	R/V BAY HYDRO II		
Echosounder	Teledyne Odom Hydrographic Odom Echotrac CV-200 200 kilohertz		
Date	2010-03-18		
Offsets	MRU to Transducer	x	2.294 meters
		y	3.406 meters
		z	2.143 meters
		x2	
		y2	
		z2	
	Nav to Transducer	x	0.0 meters
		y	0.0 meters
		z	0.0 meters
		x2	
		y2	
		z2	
	Transducer Roll	Roll	0.000 degrees
		Roll2	
Vessel	R/V BAY HYDRO II		
Echosounder	Reson SeaBat 7125 400 kilohertz		
Date	2010-03-02		
Offsets	MRU to Transducer	x	0.110 meters
		y	-1.066 meters
		z	2.507 meters
		x2	
		y2	
		z2	

	<i>Nav to Transducer</i>	<i>x</i>	-0.043 meters
		<i>y</i>	-1.217 meters
		<i>z</i>	2.342 meters
		<i>x2</i>	
		<i>y2</i>	
		<i>z2</i>	
	<i>Transducer Roll</i>	<i>Roll</i>	0.000 degrees
		<i>Roll2</i>	

C.1.2 Layback

C.1.2.1 Description of Correctors

Layback on the R/V BAY HYDRO II is the offset from the Reference Point (RP), to the point where the tow cable departs the sheave at the top of the A-frame.

C.1.2.2 Methods and Procedures

During acquisition the amount of side scan cable out is visually observed, and the value is entered into the SonarPro acquisition program. The number is then included in the .sdf file. Actual positioning of the Towfish is calculated during post processing, using CARIS SIPS.

C.1.2.3 Layback Correctors

<i>Vessel</i>	R/V BAY HYDRO II		
<i>Echosounder</i>	L3 Communications / Klein Associates, Inc. 5000HSHRSSS Towfish, T5114 Transceiver Processing Unit (TPU) 455 kilohertz		
<i>Date</i>	2010-02-26		
Layback	<i>Towpoint</i>	<i>x</i>	-0.011 meters
		<i>y</i>	-9.979 meters
		<i>z</i>	-4.01 meters
	<i>Layback Error</i>	0.00 meters	

C.2 Static and Dynamic Draft

C.2.1 Static Draft

C.2.1.1 Description of Correctors

Static draft is measured daily, and entered into the HVF file.

C.2.1.2 Methods and Procedures

Once the multibeam strut has been deployed, the distance from the benchmark to the waterline is measured using the vessel's lead line, and a steel measuring tape. The Z-axis difference between the benchmark and the RP is subtracted to get the true static draft. The new measurement is inserted into the HVF file for the Reson 7125 multibeam under that day number in the Waterline Height section.

C.2.2 Dynamic Draft

C.2.2.1 Description of Correctors

Change in draft measurement are used on the R/V/ BAY HYDRO II to account for the natural "settlement and squat" the vessel undergoes while changing speed while acquiring SWMB data.

C.2.2.2 Methods and Procedures

Using the Echosounder method, as described in the FPM section 1.4.2.1.2.1, a delta draft survey was conducted on 5 January 2011. A total of sixteen 1000m lines were run in opposite directions for each of eight different RPM's on the vessel's main engines. The initial two lines were run using a single engine, in order to maintain the slowest speed possible. The remaining fourteen lines were run using both engines. The evolution was completed by acquiring three drift lines, run orthogonal to the azimuth of the main lines. All multibeam data was processed using CARIS HIPS/SIPS 7.0 and then analyzed using the following methods: 20m X20m subset was defined at each drift line/main line intersection, all sounding inside subset were queried for depth, the median depth for lines run at the same RPM were calculated at each drift line reference area, the median depth of each drift line was calculated, and the delta draft at each line couplet at each reference point was calculated by subtracting the lines median depth from the median drift depth. The delta draft found at typical survey speeds was inserted into the Reson 7125 HVF under "TPU values, Standard Deviation, Delta Draft (m)".

C.2.2.3 Dynamic Draft Correctors

<i>Vessel</i>	R/V BAY HYDRO II								
<i>Date</i>	2011-01-05								
<i>Dynamic Draft Table</i>	<i>Speed</i>	1.029 meters/second	2.6424 meters/second	3.087 meters/second	3.498 meters/second	3.807 meters/second	4.064 meters/second	4.476 meters/second	5.093 meters/second
	<i>Draft</i>	-0.002 meters	-0.007 meters	-0.007 meters	-0.002 meters	-0.015 meters	-0.031 meters	-0.041 meters	-0.042 feet

C.3 System Alignment

C.3.1 Description of Correctors

R/V BAY HYDRO II is configured for the "Precise Timing" setup for MBES operations. In this method of minimizing timing errors, a UTC serial time stamp is output from the POS/MV and received by Hysweep and the Reson processing unit. All data (navigation, heave, pitch, roll, and bathymetry) are time stamped according to this string at acquisition. because these data are time-stamped at acquisition and the time stamp is honored in post-processing, the timing errors between navigation, heave, pitch, and roll are minimized.

C.3.2 Methods and Procedures

Patch tests were conducted throughout the year after any removal and replacement of the Reson 7125 MBES head due to the test and evaluation mission of the R/V BAY HYDRO II, These patch tests are designed to find any roll, pitch, and yaw biases and remaining time offset between the MB reference frame and the navigational reference frame. These Patch Tests are conducted in accordance with the Hydrographic Specifications and Deliverables section 5.2.4.1. In order to insure the highest quality of testing, the lines are post-processed and the CARIS Calibration Utility is performed by all R/V BAY HYDRO II crew members. The results of the three trials are averaged together and recorded in the Reson 7125 HVF under the appropriate columns in Swath 1 for the specific day number.

C.3.3 System Alignment Correctors

<i>Vessel</i>	R/V BAY HYDRO II	
<i>Echosounder</i>	Reson SeaBat 7125 400 kilohertz	
<i>Date</i>	2011-01-05	
<i>Patch Test Values</i>	<i>Navigation Time Correction</i>	0.0 seconds
	<i>Pitch</i>	2.1 degrees
	<i>Roll</i>	0.10 degrees
	<i>Yaw</i>	0.40 degrees
	<i>Pitch Time Correction</i>	0.00 seconds
	<i>Roll Time Correction</i>	0.00 seconds
	<i>Yaw Time Correction</i>	0.00 seconds
	<i>Heave Time Correction</i>	0.00 seconds
<i>Vessel</i>	S5401	
<i>Echosounder</i>	Reson SeaBat 7125 400 kilohertz	
<i>Date</i>	2011-01-31	
<i>Patch Test Values</i>	<i>Navigation Time Correction</i>	0.0 seconds

	<i>Pitch</i>	-2.0 degrees
	<i>Roll</i>	0.10 degrees
	<i>Yaw</i>	0.45 degrees
	<i>Pitch Time Correction</i>	0.00 seconds
	<i>Roll Time Correction</i>	0.00 seconds
	<i>Yaw Time Correction</i>	0.00 seconds
	<i>Heave Time Correction</i>	0.00 seconds
<i>Vessel</i>	S5401	
<i>Echosounder</i>	Reson SeaBat 400 kilohertz	
<i>Date</i>	2011-05-09	
<i>Patch Test Values</i>	<i>Navigation Time Correction</i>	0.0 seconds
	<i>Pitch</i>	2.20 degrees
	<i>Roll</i>	0.10 degrees
	<i>Yaw</i>	1.70 degrees
	<i>Pitch Time Correction</i>	0.00 seconds
	<i>Roll Time Correction</i>	0.00 seconds
	<i>Yaw Time Correction</i>	0.00 seconds
	<i>Heave Time Correction</i>	0.00 seconds

Additional Discussion

The Bay Hydro II's MBES system was originally patched on 5 Jan 2011. A potential navigation timing error was found, and the system was re-patched on 31 Jan 2011. In May 2011, the POS M/V system was upgraded, and the MBES was repatched.

C.4 Positioning and Attitude

C.4.1 Description of Correctors

Applying positioning and attitude data to Raw MBES and VBES data.

C.4.2 Methods and Procedures

The blended positional solution from the POS/MV is recorded to the "C" drive of the Hypack acquisition computer. This file is merged with the Raw data file in CARIS SIPS using the "Load True Heave" utility.

C.5 Tides and Water Levels

C.5.1 Description of Correctors

Sounding were reduced to Mean Lower-Low Water (MLLW) using final, approved zoned tide data (unless otherwise noted in the DR) from each tide station applicable for a specific survey sheet.

C.5.2 Methods and Procedures

All tide data were obtained from the Center for Operational Oceanographic Products and Services (CO-OPS) program Fetchtides.py. These data were used to create a CARIS HIPS Tide file (.tid) and were applied to MBES and VBES data within CARIS HIPS. Refer to individual Descriptive Reports for further information regarding water levels specific to each survey.

C.6 Sound Speed

C.6.1 Sound Speed Profiles

C.6.1.1 Description of Correctors

Speed of sound measurements in the water column are used to correct for the effects of salinity, temperature, and conductivity changes within the water column.

C.6.1.2 Methods and Procedures

CTD casts taken using the SeaBird CTS and are processed using HSTP's VELOCIPY software. The Profile created is then applied to MBES, SSS, and VBES data in CARIS HIPS using the Sound Velocity Corrections utility.

C.6.2 Surface Sound Speed

C.6.2.1 Description of Correctors

Speed of sound measurements at the Reson 7125 transducer face are used by the unit to correctly form it's beams.

C.6.2.2 Methods and Procedures

The R/V BAY HYDRO II use the Digibar Pro to acquire speed of sound at the face of the RESON 7125 transducer, and the data is sent real time to the RESON processor unit

